

## REMARKS

Reexamination and reconsideration of the subject application, pursuant to and consistent with 37 C.F.R. § 1.104 and § 1.112, and in light of the following remarks, are respectfully requested.

The rejections in the final Office action are based on the following references: JP '250 (JP 10-173250) and Inoi *et al.* (US 6,097,132). The JP '250 application has a publication date of 26 June 1998. Inoi *et al.* has a U.S. filing date of 23 July 1998.

The present application is based on PCT/JP99/02888, claiming priority from two Japanese applications, including JP 149660/1998, filed 29 May 1998, a date prior to both of the references cited in the final rejection. Enclosed is a translation of the specification, the drawings, and the abstract from Patent Abstracts of Japan, the translation obtained on-line from the Japanese Patent Office IPDL Patent and Utility Model Gazette DB, of the JP '660 application, as published as JP 11-346015. The Corrected Filing Receipt mailed 01/02/2001 identifies the JP/02888 PCT application and the two Japanese applications.

With regard to the rejection of claims 4-6 under §102 based on JP '250, the abstract of applicants' published JP '015 specification, antedating the date of the reference, clearly shows and describes at least two pairs of output electrodes and second electrodes kept at the same potential; also disclosed in that abstract is the mounting on a circuit board. Accordingly, JP '250 is not available as prior art because applicants' '660 JP priority application discloses the same, and so the rejections based on JP '250 should be withdrawn.

With regard to the rejection of claims 10-11 under §103 based on Inoi, it is first noted that patent drawings are not to scale. *Nystrom v. Trex Co.*, 71 USPQ2d 1241 (Fed. Cir. 2004); *In re Wolfensperger*, 133 USPQ 537 (C.C.P.A. 1962); *Ex parte Horton*, 226 USPQ 697 (B.P.A.I. 1985); *Ex parte Randall*, 123 USPQ 390 (B.P.A.I. 1959). While the description of the "ring-shaped elastic body" at column nine is noted, the description of width  $q_1$  as 9.5mm is believed to be in error: in column 10 is a discussion of the width  $q_1$  and the placement of the elastic body —  $q_1$  should be of a width between 1mm and 2mm (at lesser widths noise increased, and at greater widths energy conversion decreased; see lines

50-61 at column 10); and consistent with the disclosure at column nine, it should be within 3mm of the node. Because the description of the width in column nine is inconsistent with the more detailed description in column 10, the description in column nine is believed to be in error. Therefore, 2mm of the 42mm length is much less than the approximately 8mm that would constitute about 1/5 of the 42mm length (and two mounting elastic bodies would be 4mm, just less than 1/10th of the 42mm length). In addition, the position of the node is defined in Inoi with respect to the position of the electrode (col. 7, ln. 38-46) and does not appear to be located by any specific dimensions. Accordingly, at best there is a description of where the elastic mounting body should be placed with respect to the node, but there is no disclosure, teaching, or suggestion for placement of the elastic body with respect to the "full length of said transformer from both ends thereof" as recited in claim 10. Accordingly, this rejection should now be withdrawn.

With regard to the rejection of claims 7-9 and 12-17 under §103 over Inoi in view of JP '250 and applicants' Fig. 1, as these claims depend from claim 10 which was just argued to be unobvious over Inoi, and it has been shown that JP '250 is not available as prior art, and applicants' Fig. 1 does not show the mounting, this rejection should now be withdrawn.



# PATENT ABSTRACTS OF JAPAN

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(71)Applicant : TOKIN CORP

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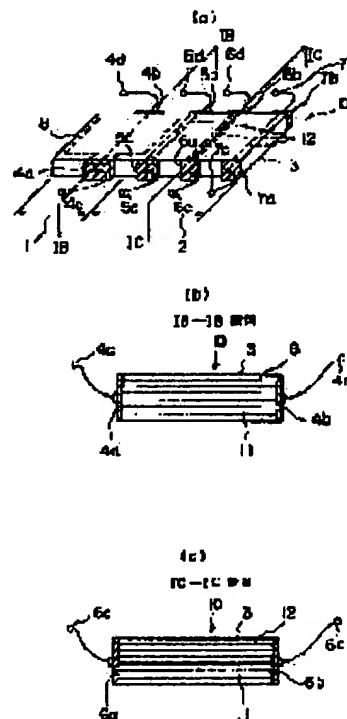
(72)Inventor : KUMASAKA KATSUNORI

## (54) PIEZOELECTRIC TRANSFORMER

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a piezoelectric transformer capable of mounting a very thin type piezoelectric inverter also improving the reliability thereof as well as the sound pressure level of audible sound without deteriorating the electrical characteristics such as pressure up ratio, heat generation.

**SOLUTION:** In a piezoelectric transformer having a piezoelectric transformer element 10 equipped with a laminated body 3 made of inner electrodes 8 and piezoelectric ceramic layer 11 alternately laminated in the board thickness direction, the first electrodes 4a, 4b connected to the inner electrodes 8 provided on the side of the laminated body 3 as well as at least a pair of the second electrodes 5a, 5b, 6a, 6b, 7a, 7b to be in the same potential oppositely provided on the side of the different parts from that of the first electrodes 4a, 4b and a circuit board for driving the piezoelectric transformer element 10, the piezoelectric transformer element 10 is mounted on the circuit board as well as the circuit board is electrically connected to respective opposing electrodes of at least a pair of the second electrodes 5a, 5b, 6a, 6b, 7a, 7b.



## LEGAL STATUS

[Date of request for examination]

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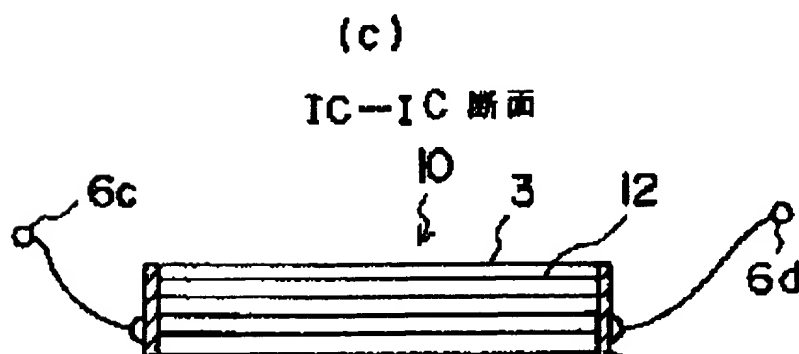
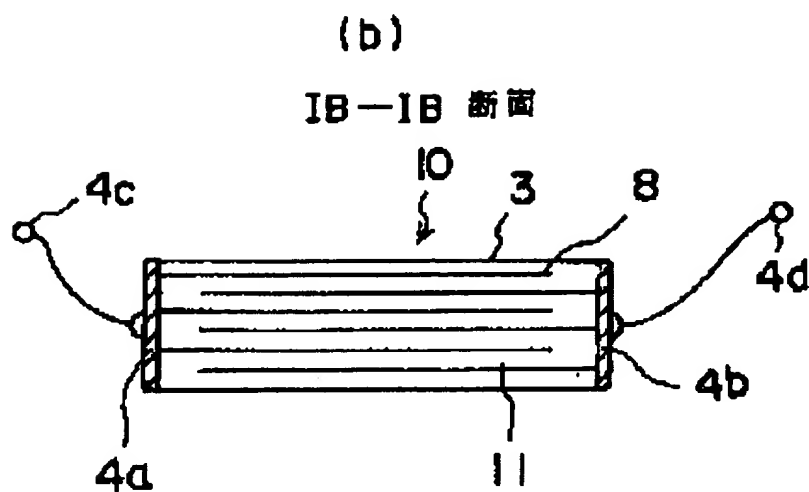
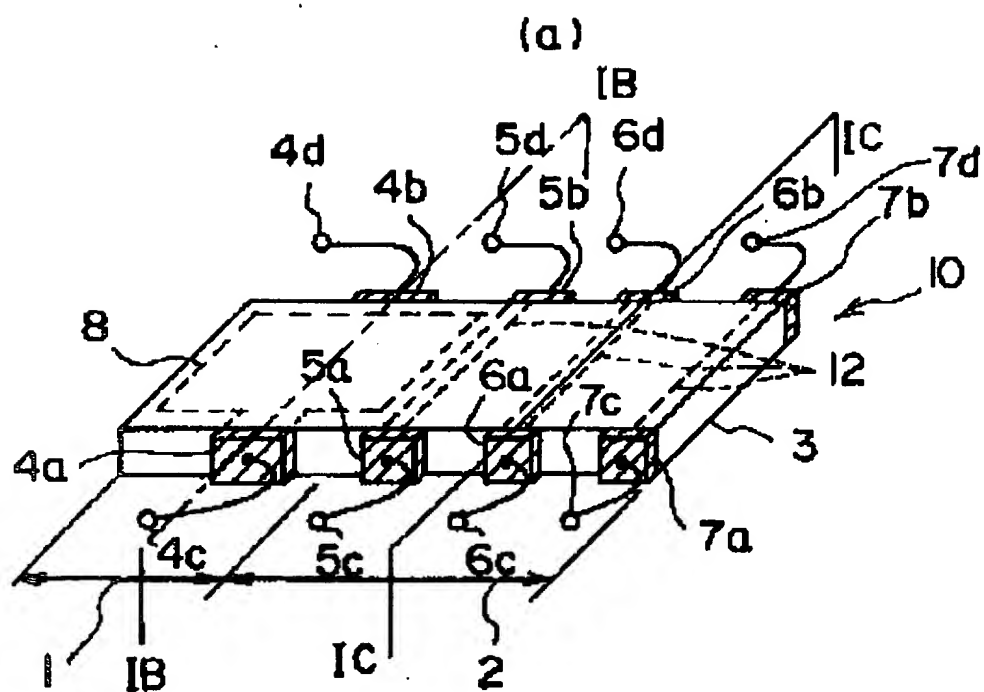
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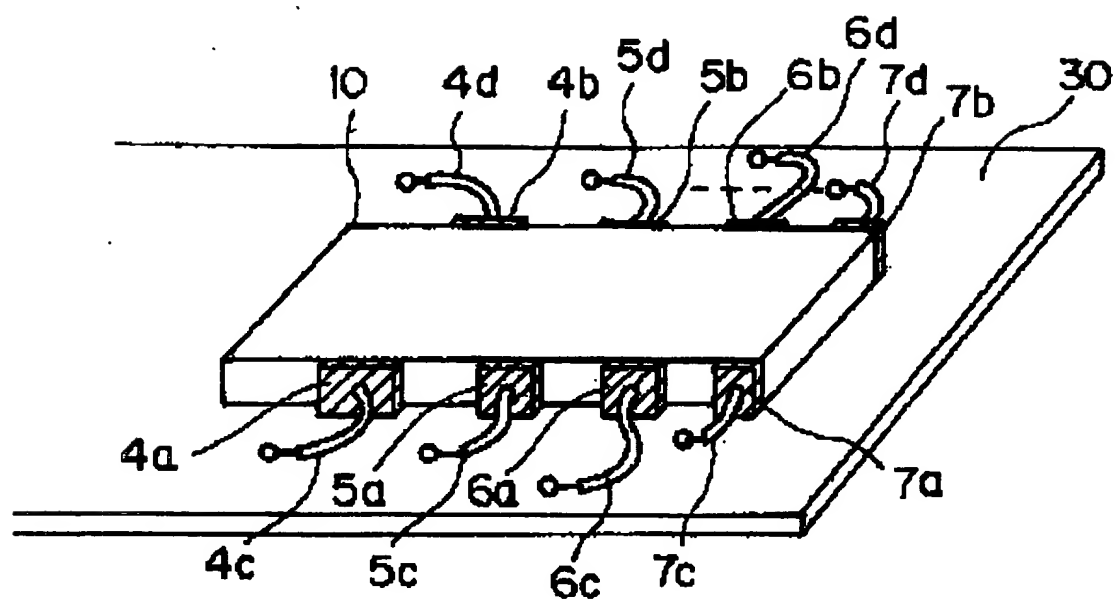
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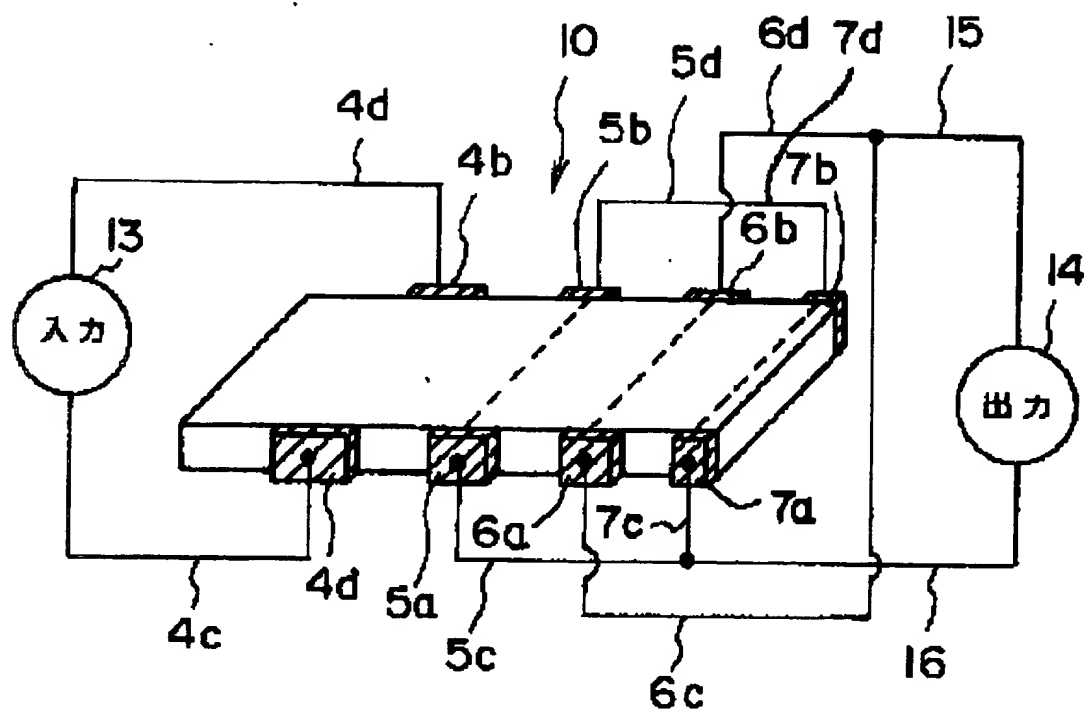
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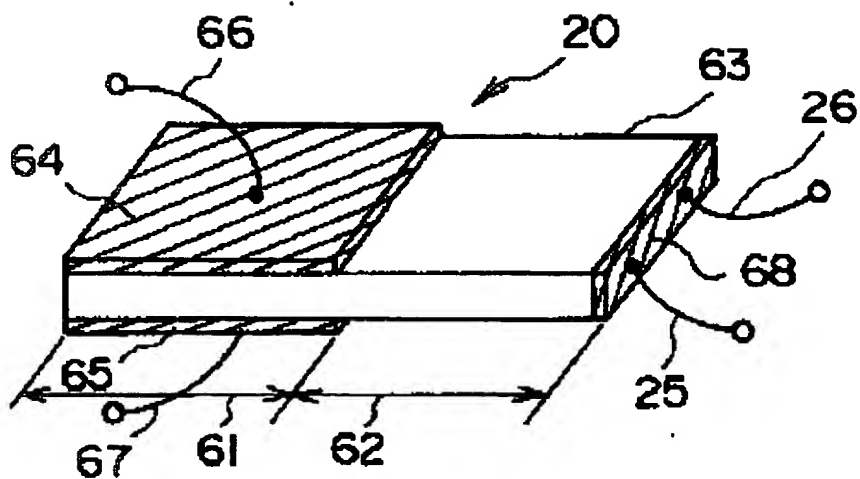
DWG. 1



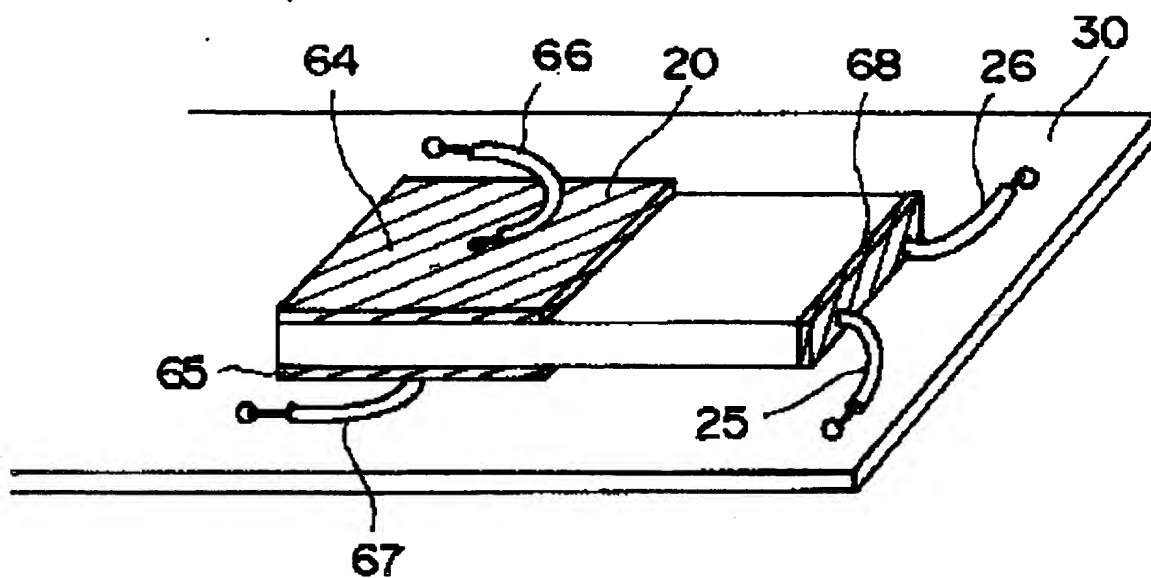
Dwg 2



Dwg. 3

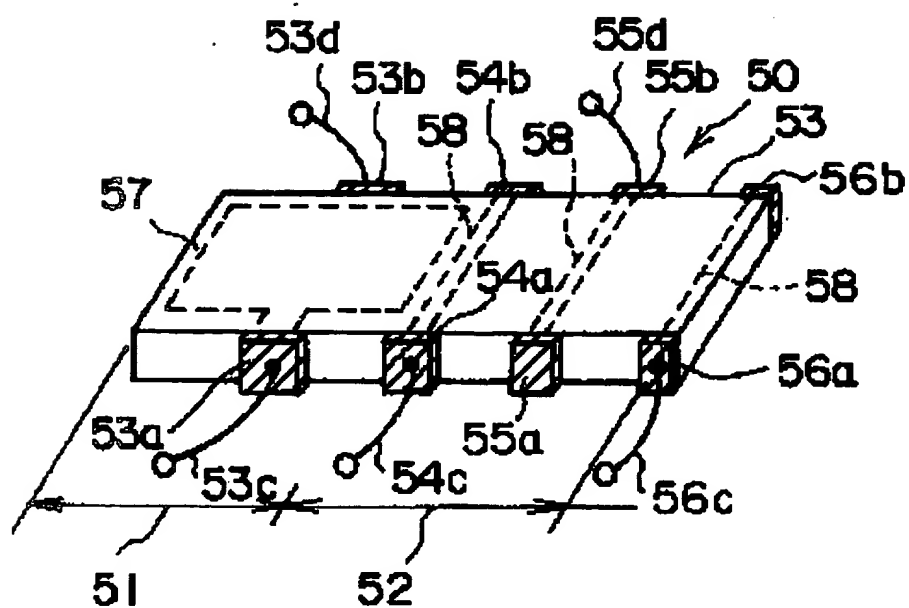


Dwg. 4



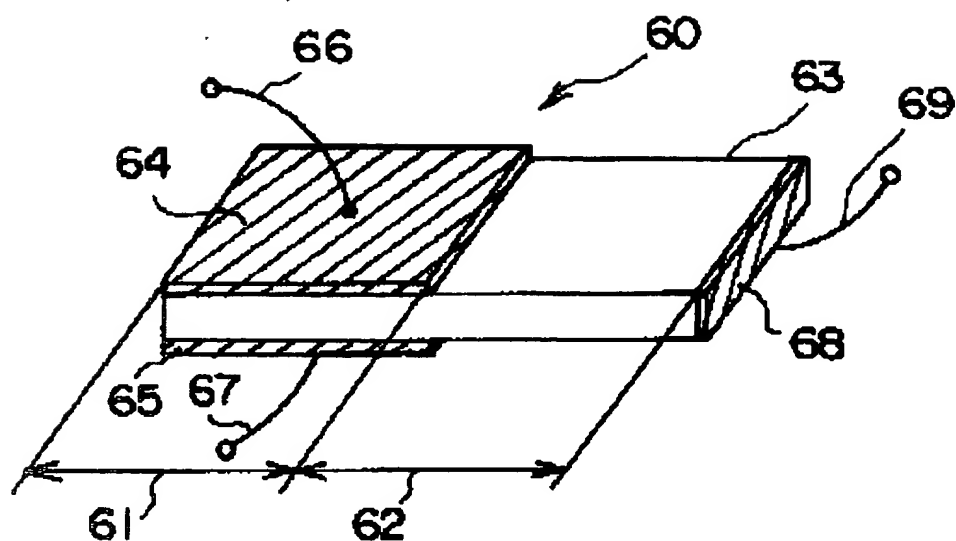
DWG. 5





変形ローゼンタイプ

DWG-6



ローゼンタイプ

DWG. 7

## \* NOTICES \*

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the structure of an output electrode, and mounting of the circuit board in detail about the piezoelectric transformer used for the inverter circuit for the cold cathode tube back lights of liquid crystal display panels, such as a notebook sized personal computer and car navigation, an adapter power circuit, the high-pressure generating circuit used for an electronic copying machine.

[0002]

[Description of the Prior Art] Conventionally, the piezoelectric transformer component shown in drawing 6 is known. The piezoelectric transformer shown in drawing 6 is henceforth called a deformation ROZEN type piezoelectric transformer component in explanation. The laminating of an internal electrode 57 and the piezoelectric-ceramics layer is carried out by turns, the piezoelectric transformer component 50 forms a layered product 53, and the die-length direction abbreviation one half of this layered product is made into the input section 51, and it makes the remaining one half the output section 52. That by which that of the internal electrodes piled up a piezoelectric-ceramics layer and by turns adjoins the input section 51 is mutually pulled out by the reverse side face, and is connected to the input electrodes 53a and 53b formed in the side face of a layered product 53, respectively. On the other hand, the laminating of the band-like electrode 58 is carried out in the die-length direction of a layered product by turns in a list and a piezoelectric-ceramics layer, and the output section 52 is formed. It exposes to a both-sides side and the both sides of this electrode 58 are connected to the output electrodes 53a and 53b formed so that a both-sides side might be counterer and a pair might be made, 54a and 54b, and 55a and 55b.

[0003] The lead wire 54c, 55c, and 56c with which it connected at the input side and the lead wire 53c and 53d with which the electrical installation of the piezoelectric transformer component and the circuit board which are shown in drawing 6 was prepared in input electrodes 53a and 53b, respectively was formed in output electrodes 54a, 55b, and 55a is connected to an output side. Lead-wire 55c of the output section 52 is high potential, and lead wire 54c and 56c is low voltage, and it has this potential.

[0004] Moreover, about the terminal structure and electrical installation of the output section 52, Leads 54c, 55c, and 56c were connected to the circuit board, respectively.

[0005] The piezoelectric transformer component shown in drawing 7 is called a ROZEN type, and is well known with the piezoelectric transformer component of drawing 6. As shown in drawing 7, the piezoelectric transformer component 60 forms the electrode 68 in the end face of the side in which electrodes 64 and 65 are formed in the front rear face of the die-length direction abbreviation one half of the electrostrictive ceramics rectangle plate 63, and electrodes 64 and 65 are not formed. In the piezoelectric transformer component 60 of this structure, the leads 66 and 67 connected to electrodes 64 and 65 serve as an output terminal of the output section 62, and the lead connected to the electrode 68 is held at high potential.

[0006]

[Problem(s) to be Solved by the Invention] However, since the demand range of a brilliance control was expanded to the inverter which used the piezoelectric transformer, adoption of burst modulated light increased as the correspondence. Consequently, by the conventional mounting method, generating of the audible sound which was not made has posed a problem. Although this was driving vibration of a piezoelectric transformer by the single oscillation mode mostly conventionally, when it adds a modulated light function, a piezoelectric transformer stops being vibration of a single mode, and the effect has produced it in the electrical installation section.

[0007] Constraint joined the technical problem the oscillation mode becomes less single [ a technical problem ], the area which performs electrical installation to the electrode structure of a piezoelectric transformer component with the shift to a still smaller thin shape, and the problem of the dependability about the electrical installation of a piezoelectric transformer component and the circuit board has arisen.

[0008] Then, 1 technical technical problem of this invention can improve the sound pressure level of audible sound, and degradation is not seen but electrical characteristics, such as a pressure-up ratio and generation of heat, are to offer the piezoelectric transformer which can aim at improvement in dependability.

[0009] Moreover, another technical technical problem of this invention is to offer the piezoelectric transformer which can realize a very thin piezo-electric inverter.

[0010] Furthermore, it is in offering the piezo-electric inverter power source of this invention for which another technical

technical problem used the above-mentioned piezoelectric transformer further.

[0011]

[Means for Solving the Problem] The layered product which comes to carry out two or more laminatings of an internal electrode and the piezoelectric-ceramics layer in the direction of board thickness by turns according to this invention, The piezoelectric transformer component which is countered and prepared in the side face of a different part from the 1st electrode connected to said internal electrode prepared in the side face of said layered product, and said 1st electrode, and serves as this potential mutually and which was equipped with the 2nd electrode of a pair at least, In the piezoelectric transformer which has the circuit board for driving said piezoelectric transformer component, while carrying said piezoelectric transformer component in said circuit board The piezoelectric transformer characterized by carrying out electrical connection of said each electrode with which the 2nd electrode of a pair counters at least and said circuit board, respectively is obtained.

[0012] Moreover, according to this invention, in said piezoelectric transformer, said 2nd electrode is formed together with two or more pairs die-length directions, each electrode of each set of said 2nd electrode is connected to the output terminal of this potential, and the piezoelectric transformer characterized by connecting with said circuit board as an output terminal of said 2nd electrode from which a \*\*\*\*\* electrode differs mutually, respectively is obtained.

[0013] Moreover, the body of a piezoelectric transformer which consists of the layered product or the single piezoelectric-ceramics layer which comes to carry out two or more laminatings of an internal electrode and the piezoelectric-ceramics layer in the direction of board thickness by turns according to this invention, And it sets to the piezoelectric transformer which has the \*\*\*\* transformer component which has the output electrode prepared in the end section of said body of a piezoelectric transformer, and the circuit board for driving said piezoelectric transformer component. The terminal of two points is prepared in said output electrode, and the piezoelectric transformer characterized by carrying out electrical connection of said terminal of two points to said circuit board is obtained.

[0014] Moreover, according to this invention, in said piezoelectric transformer, the piezoelectric transformer characterized by equipping said body of a piezoelectric transformer with the input electrode of the pair which countered a part of opposed face which makes a front flesh side is obtained.

[0015] Moreover, according to this invention, in said one of piezoelectric transformers, the piezoelectric transformer characterized by using lead wire or FPC for the electrical connection of said piezoelectric transformer component and said circuit board is obtained.

[0016] Furthermore, according to this invention, the inverter power source characterized by using said one of piezoelectric transformers is acquired.

[0017]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.

[0018] Drawing 1 (a) is the perspective view showing the piezoelectric transformer by the gestalt of operation of the 1st of this invention. The sectional view where drawing 1 (b) met the IB-IB line of drawing 1 (a), and drawing 1 (c) are sectional views which meet the IC-IC line of drawing 1 (a).

[0019] If drawing 1 (a), (b), and (c) are referred to, the piezoelectric transformer component 10 is a deformation ROZEN type piezoelectric transformer component, will carry out the laminating of rectangle-like an internal electrode 8 and the band-like connection electrode 12, and the piezoelectric-ceramics layer 11 by turns, and will form the layered product 3. The die-length direction abbreviation one half of this layered product 3 is made into the input section 1, and the remaining one half is made into the output section 2. The piezoelectric-ceramics layer 11 is the PZT system, the connection electrode 12 consists of silver and palladium, and each external electrode consists of silver or silver, and palladium.

[0020] That by which the input section 1 is adjoined of the internal electrodes 8 piled up the piezoelectric-ceramics layer 11 and by turns is mutually pulled out by the reverse side face, and is connected to the input electrodes 4a and 4b formed in the side face of a layered product 3, respectively. Lead wire 4c and 4d is formed in these input electrodes 4a and 4b, respectively.

[0021] On the other hand, the laminating of the band-like connection electrode 8 is carried out in the die-length direction of a layered product 3 by turns in a list and the piezoelectric-ceramics layer 11, and the output section 2 is formed. It exposes to the both-sides side of a layered product 3, and the both sides of this connection electrode 8 are connected to the output electrodes 5a and 5b formed so that a both-sides side might be countered and a pair might be made, 6a and 6b, and 7a and 7b. Each output electrode 5a and 5b, 6a and 6b, and 7a and 7b are connected to lead wire 5c and 5d, 6c, 6d, and 7c and 7d, respectively. The electrodes of the high-voltage section of the output section 2 are 6a and 6b, and 6a and 6b have taken the flow electrically. Moreover, the electrodes 5a, 5b, 7a, and 7b of the low-battery section have also taken the same structure as the above-mentioned electrodes 6a and 6b.

[0022] Drawing 2 is the perspective view showing the condition of having mounted the piezoelectric transformer component shown in drawing 1 in the circuit board.

[0023] The lead wire 5c and 5d processed by just the eight predetermined die length of \*\*\*\*\* of the external electrodes 4a, 4b, 5a, 5b, 6a, 6b, 7a, and 7b of the piezoelectric transformer component 10 shown in drawing 1, 6c, 6d, and 7c and 7d are soldered. Next, silicon adhesives etc. paste up the knot section of vibration on the circuit board 30 using a silicon sheet, and the piezoelectric transformer component 10 by which lead processing was carried out is soldered to the specified circuit board 16 at eight places each lead wire 5c and 5d, 6c, 6d, and 7c and 7d. In addition, in the gestalt of the 1st operation, although lead wire was soldered, even if it uses a flexible-printed-wiring substrate (FPC), solder connection can be made

similarly.

[0024] Drawing 3 is the circuit diagram of the inverter power source which used the piezoelectric transformer component of drawing 2.

[0025] As shown in drawing 3, it connects with the circuit 13 of an input side, and the lead wire 4c and 4d of an input side is short-circuited, it was collected, and inputted into the end section of an output side through one path cord 15, and the lead wire 5c and 7c of an output side has inputted [ the lead wire / the lead wire 5d and 7d of an output side was packed, and ] the leads 6c and 6d of an output side into the other end of an output side as one path cord 16.

[0026] According to the piezoelectric transformer of the gestalt of operation of the 1st of this invention of such a configuration About the electrode structure of the output section 2 of the deformation ROZEN type piezoelectric transformer component 10, as shown in drawing 1 (a), drawing 1 (b), and drawing 1 (c) By preparing the external electrode of the output section 2 in both sides, and taking structure like drawing 1 (c) for the interior of the piezoelectric transformer component of an output side 12, and making it lead-wire 5c, 5d and 6c, 6d and 7c, and the structure of taking a flow electrically 7d Vibration of a piezoelectric transformer serves as bilateral symmetry in the die-length direction, and sound pressure RE \*\* RU of audible sound can be reduced. An output side 2 The lead wire 6c and 6d by the side of high potential, It will have two places each by the lead wire 5c and 5d by the side of low voltage, and 7c and 7d, and the piezoelectric transformer from which electrical characteristics do not change even if a problem arises in one-place electrical installation is obtained.

[0027] The property of the piezoelectric transformer component by the gestalt of operation of the 1st of this invention is shown in the following table 1.

[0028]

[Table 1]

| 項 目         | 従来品    | 本発明品   |
|-------------|--------|--------|
| 昇圧比 ー       | 9 0    | 9 1    |
| 駆動周波数 k H z | 6 4. 5 | 6 4. 5 |
| 発熱 C        | 1 8    | 1 7    |
| 可聴音 d B     | 7 0    | 6 2    |

本発明品：変形ローゼンタイプ（第1の実施の形態）

[0029] As shown in the above-mentioned table 1, in the deformation ROZEN type piezoelectric transformer component, it became clear that it was clear that audible sound can be reduced by about 8dB, and degradation of electrical properties, such as a pressure-up ratio and generation of heat, was not seen, and improvement in dependability could be aimed at.

[0030] Drawing 4 is the perspective view showing the piezoelectric transformer component by the gestalt of operation of the 2nd of this invention. The piezoelectric transformer component 20 shown in drawing 4 is called the ROZEN type. The electrode 68 is formed in the end face of the part of the near electrostrictive ceramics rectangle plate 63 with which this transformer component 20 forms electrodes 64 and 65 in the front rear face of the die-length direction abbreviation one half of the electrostrictive ceramics rectangle plate 63, and electrodes 64 and 65 are not formed. In the conventional piezoelectric transformer component 60 shown in drawing 7, it differs from what is depended on the conventional technique in that two lead wire 25 and 26 is formed in the electrode 68. In the piezoelectric transformer component 20 of this structure, the lead wire 66 and 67 connected to electrodes 64 and 65 serves as an input terminal of the input section 62, and the lead wire 25 and 26 connected to the electrode 68 is held at high potential.

[0031] Drawing 5 is drawing showing the condition of having carried the piezoelectric transformer component 20 of drawing 4 in the circuit board 30. As shown in drawing 4 and drawing 5, even when a between title arises in one electrical connection by forming lead wire 66 and 67 in the output side of the ROZEN type piezoelectric transformer component 20 two places, the piezoelectric transformer from which electrical characteristics do not change can be obtained.

[0032] In addition, also in the gestalt of the 2nd operation, it became clear that degradation of an electrical property was not seen as compared with the conventional technique, and improvement in dependability could be aimed at.

[0033]

[Effect of the Invention] As mentioned above, according to this invention, as explained, it considers as the structure of the symmetry to vibration of a piezoelectric transformer, and the sound pressure level of the audible sound which was a problem can be reduced, degradation is not seen but electrical characteristics can offer the piezoelectric transformer which can aim at improvement in dependability.

[0034] Moreover, according to this invention, the piezoelectric transformer which can realize a very thin piezo-electric inverter can be offered.

[Translation done.]